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Title: Fault diagnostics system for electrical drives

Arrangement for fault diagnostics and/or analysis of one or more technical physical processes, in particular electric drive operation, which run by using one or more process computer nodes for controlling, regulation and/or observation, wherein the process computer nodes are connected to at least one diagnosis computer node, in which one or more diagnosis services and/or functions are implemented, which are assigned to the one or more processes and/or one or more process computer nodes, which are assigned to these, and/or the working processes running therein, via a shared bus.

The following data are taken from the documents submitted by the applicant.

Description

The invention relates to a computer arrangement, a computer based system as well as a computer based method for fault diagnosis and/or analysis of one or more technical-physical processes, in particular electric drive operation, which run using one or more process computer nodes for controlling, regulation and/or observation.

As a result of the development status in technical computer science achieved today fast micro processor systems are able to undertake the management of controlling and regulation as well as information transfer. This existing level of automation involves a complexity of production systems and facilities which require specialists, who have to be provided with correspondingly complex means for fault searching, for maintenance and repair. This is due to the fact that the speed of web in highly automated production systems reaches 10 meters per second nowadays, in which more than 1000 information dates accumulate and have to be processed within a few milliseconds. Specialised measuring equipment with extremely high resolution has to be used for this purpose. This high resolution is necessary to get the required accuracy of individual drive components to each other at this high velocity (the drives for example affect the same weblike medium without being mechanically connected to each other). As important as the dynamic signals are the informations of the observation devices, which can be used in numbers at a production system. They are used to protect humans and machines from hazard and to indicate conditions, which are dangerous or in need of maintenance, and to cut off production if necessary.

The problem underlying the invention consists of providing a system for fault diagnosis and analysis, which not only is able to hold information about the actual status of a complex, computer based production system ready, but also enables and assists the determination of the reasons of failures. In this respect the diagnosis system has further to be able to store historical and chronologically backdated data respectively and to hold ready for future uses. In spite of storing great masses of data with most diverse attributes the technical process as well as the accompanying process computers must not be loaded noticeable in a way, that technical processes are affected and inadmissibly changed as well as production processes are slowed down thereby. The accumulating process data has to be evaluable in real time and in online operation and in the case of an irregularity to be analysable prior to the occurrence.

For solution of this problem complex with an arrangement incorporating the features named above it is proposed according to the invention to connect the process computer nodes via at least one shared bus with at least one diagnosis computer node, in which one or more diagnosis services and/or functions are implemented, which are assigned to the one or more processes and/or the one or more process computer nodes and/or the production processes running therein. The process computer nodes are usually connected via a shared bus system, if they conduct and/or control parallel and/or simultaneously running technical processes. An additional computer node, which then can perform diagnosis services and/or

functions, can be easily attached to this bus. The process computer nodes can call on diagnosis services from the diagnosis computer on demand for example. Since in digital computer based conducting and controlling of technical processes the processing of data for controlling, regulation and visualisation occurs digitally as far as possible, the digital process data which are available anyway can be used by the invention for analysis and fault diagnosis efficiently. The modules, which enable the analysing of the conditions of the production systems adjusted to the specific level of automation, could be contained at least partially in the diagnosis computer, similar to a „tool box". Furthermore, only a minimal load to the already working computer architectures, particularly concerning their main memory, is associated with the activation of the diagnosis computer as an autarkic system. The diagnosis services and functions can run conveniently distributed on diagnosis computer nodes and process computer nodes, thereby using the full computing power of all connected computer nodes.

To comply with essential international regulations and guidelines is to be striven at with micro processor controlled systems. This applies particularly to the communication of different autonomous systems. Corresponding messages, transmission protocols and field bus systems are integrated therein. Fast field bus systems have to be connected with bus topologies of high capacity computer networks in the field of drives. Particularly in commonly known direct drive technique a highly dynamic drive concept has been implemented. The connection of the diagnosis computer according to the invention for this purpose is eagerly possible. Relevant analogue and digital data can also be recorded autonomously from the technical process, e. g. via analogue/digital converter, using this computer. Strategies and algorithms ensuring a reliable detection of failures can be implemented. The process computer nodes are accessible by the diagnosis computer nodes because of bus compatibility. Updated software parameters can be fed into the diagnosis computer via download if a component assembly change in a process computer node is necessary. Easy operation of the diagnosis computer is ensured by a graphical user interface. User areas with password protection can be configurable therein.

With particular advantage the diagnosis computer is superordinate to the one or more process computers in the context of a master/slave structure. The diagnosis computer can for example request security relevant process data at any moment using priority over most other working processes in the process computers therewith.

In an alternative implementation of the system according to the invention the diagnosis computer is equipped with one or more field oriented interfaces, for example analogue/digital converter, pulse counter and/or binary switches. This can be carried out by the mounting of a micro controller card and a micro controller network respectively (optional and user specific), which are designated for direct reading of analogue and digital measured values. Interference proof fibre optic cables can serve as transmission medium.

As solution for the said problem complex with a computer based system for fault diagnoses with the

said features, a message server module reading process data via message protocol drivers implemented on the diagnosis computer nodes and process computer nodes repeatedly, and further a database module storing and/or archiving the data obtained from the massage server module for future access, wherein the operation module communicates with the message server module and the database module at least partly under the control of the operating system in the diagnosis computer node, is proposed according to the invention. By interaction of the message server module and the database module a possibility to log process relevant data particularly in real time is provided. The reason for eventual failures and malfunctions and damage events can be objectively investigated after the event out of this. As a result of the message protocol driver on diagnosis computer nodes and process computer nodes, which can be endorsed with real time data channels if necessary, a constant monitoring eye on every process computer node results for the message server module.

To ensure the controlling and administration for archiving of process data in the database module, a parameter module co-operating with the database module and/or the message server module is provided with particular advantage, which is designed for identification and/or interpretation of the process data read by the message server module from the process computer node and/or for controlling of their storage and/or maintenance and/or display from the database module. The said parameter module can equally form the control unit for the database and/or for the message server. Preferably it is exclusively configurable via the operating system, so that client users can not access thereon of hand. Simultaneously, this results in a clearly arranged division of the accumulating informations in such manner, that process data is exclusively stored in the database module and controlling parameters for the handling of process data are exclusively stored in the parameter module. With the parameter module, particularly the message server module, the database module and/or the process computer nodes can be configured and used for miscellaneous purposes. Even the method of messaging of malfunctions, failures or changes in the technical process can be adjusted in the parameter module (message parameterisation).

Basically it is sufficient, if message server module and database module communicate directly with each other, and the parameter module acts directly only upon the database module. It is alternatively possible, that the message server receives control signals and informations also directly from the parameter module. According to another alternative the database module is only connected to the parameter module, which on his part also communicates directly with the message server.

In order to have the diagnosis of failures and the evaluation of the reasons, carried out correctly with highly dynamic technical processes, particularly with highly dynamic drive procedures, a operating system offering multitasking is advantageous (for example by using WINDOWS NT). In implementations of the diagnosis system not diagnosing direct drives the operating system WINDOWS 3.1 without multitasking can be used equally.

In order to recognise failures via the message server module in combination with a database and parameter module, it is functional to create coupled tables by these modules for comparison between old an new process data of the same type. If a failure is noticed the allocation of a real time data channel (real time pipe) to the process computer node affected by the failure can be carried out by the parameter module. The reading of this real time data channel can then be initiated by the message server module, and the read process data is stored in the database for later analysing and evaluation.

For implementation of the real time data channels commonly known data buffers or waiting queues can be used, which are physically stored in the diagnosis and/or process computer nodes.

For solution of the said problem complex a method with the features explained above using the said diagnosis systems is proposed, in which the message server module repeatedly requests and reads specific values and other data from the process computer nodes, which characterise the technical-physical processes and/or working processes, and compares these new process data with a process image based on preceded process data of the same type from the database module, and generates an actualised process image in the case of changes and/or failures and enters the process image into the database module, as well as a notification program particularly in combination with a operation module and/or an operating oriented process computer node, for example control station computer, is parameterised. Any change, at least if it is not specified previously, thus triggers a recording of data corresponding to the process signals and working process signals respectively into the database. The change or failure is identified by regular, preferably periodic old/new comparison of process data of the same type, which are requested at different points of time from the message server. The advantage achieved by this concept is that the storage capacity of the diagnosis system is uncommonly stressed only if unintentional changes or failures arise, which do not conform with the specified normal course of the process. Not all consecutively accumulating process dates need to be stored anyway; a series of process data forming the history will only be kept stored if it is needed for evaluation of the reason of failures occurring in or immediately after this series.

It is advisable to buffer the process data due to the high speed requirements for the data transmission, for example in a pipe, waiting queue, table or such like. A table module is especially suited to carry out the said old/new comparison between newly requested and older process data, which is archived in the database.

In another embodiment of the method according to the invention the parameter module of the diagnosis system is used to keep bus addresses, type, specifications for identification, internal notations, surveillance flags and such like specifically ready for each process computer node for access by the database module and/or message server module. The parameter module can particularly be used to provide the database module and/or message server module with specifications and parameters respectively, which are necessary for the recognition of changes and/or

failures of the new read process data with the historical process data. This can for example be carried out by pointer or indirect addressing: If, for example, a process date for the actual rotational speed is requested from a process computer node with direct access to the rotational speed of an electrical drive, the message server module can simultaneously access information and parameters respectively for admissible limits of the rotational speed hysteresis indirectly via pointer addressing or relative addressing. The database module and/or parameter module itself can then be unburdened of these parameters values, which is beneficial for their storage capacity.

It conduces to the retrospective, objective investigation of the reasons for occurred failures, if in an embodiment of the method according to the invention using a diagnosis system with real time data channels for recognition of changes or failures by the message server and/or parameter module the one or more effected process computer nodes a real time data channel is assigned respectively, which discharges in the data base module for later, retrospective analysis. In doing so it is advantageous, if the real time data channel posses priority over other data transmission processes on the basis of waiting queues or buffer memory in the case of such a failure.

Additional details, features and advantages on the basis of the invention result from the following description of preferred embodiments of the invention as well as by means of the drawings. These show in:

Fig. 1 the structure of a freely configurable diagnosis apparatus according to the invention in schematic graphical depiction,

Fig. 2 a software block diagram for the freely configurable diagnosis system according to the invention in schematic depiction, and

Fig. 3 a simplified flow-chart of the diagnosis method according to the invention.

According to fig. 1 control station process computers 2a, 2b, which can be redundant if necessary, two control process computers 3a, 3b, which can also be redundant if necessary, as well as a plurality of field process computers 4a, 4b, 4c, 4d, 4e are connected in parallel with a first bus 1. The control process computers 3a, 3b are preferably designed to be freely programmable. The field process computers 4a-4e feature direct accessibility to technical-physical processes, for example on drive operation of electric motors 5 with converter modules 6 switched in. The field process computers 4a-4e are hierarchically subordinate to the control process computers 3a, 3b, which supply global control and regulation strategies, as well as the control station process computers 2a, 2b. A diagnosis computer 7 is connected directly with the control station process computers 2a, 2b via a second bus 8. The diagnosis computer 7 can communicate with the control process computers 3a, 3b indirectly via the control station process computers 2a, 2b. Alternatively it is possible for the diagnosis computer to communicate with the one or more control process computer 3a, 3b via a commonly known dual-port RAM. The second bus 8, to which the controll station process computers 2a, 2b and the diagnosis computer 7 are

connected parallel, operates conveniently using the commonly known standard protocol TCP/IP (Transport control protocol/Interface program). A third bus 9, which can for example be implemented as serial field bus according to the standard RS 485, is arranged starlike in respect to the second bus 8. The field process computers 4a-4e are connected parallel thereto. The diagnosis computer 7 is superordinate to the other process computers 2a-4e in a hierarchy according to the master/slave principle via the second and third bus 8, 9 converging starlike in the diagnosis computer 7. The diagnosis computer 7 is further equipped with an IDSN (integrated service digital network) connector offering the possibility of remote diagnosis.

The freely configurable diagnosis system according to fig. 2 is basically designed to comply with the following requirements:

- autonomous recording of relevant, digital process data as well as analogue measurements via analogue/digital converters directly from the technical processes,
- secure recognition of failures not only in the technical processes, but also in the working processes of the assigned process computer nodes,
- collection of all relevant process data of the connected process computer nodes via said real time data channel, if machine failures occur,
- addressability of process computer nodes within the system configuration (fig. 1), especially via the master/slave relationship between diagnosis computer and process computer node,
- handing over of the actual software parameters via download in case of necessary change of components in the system,
- connection of the diagnosis system according to fig. 2 to the public telephone network, for example by means of a modem or said ISDN connector 10 according to fig. 1,
- simple usage of the diagnosis system by means of a graphical user interface,
- possibility to configure user spaces with password protection,
- configurable client/server structure,
- supply of configurable data lists.

The software modules shown in fig. 2 in a simplified overview conduce to fulfilment of this profile of requirements. The substantial modules can be broken down to the operating system 11 with modular built protocol drivers 12, the message or communication server 13, the operation module 14 and the relational data base 15. The protocol driver 12a connected to the serial bus 9 represents a universal serial interface (USS) according to the standard. The further protocol driver 12b serving for remote service and remote diagnosis 16 respectively is a submodule of the operating system „WINDOWS NT 3.51", known as „RAS" (remote access

service). The third protocol driver 12c, serving for message transmission with the third-party system 17 via the second bus 8 (see fig. 1) has already been commented on the basis of fig. 1. The second protocol driver 12b (RAS) operates as commonly known with a modem. The known ethernet can be used for network connection or extension from diagnosis system 18 to third-party system 17 (for example the process computers 2a-4e according to fig. 1). A commonly known runtime library (DLL - dynamic library link) is conveniently used as communication connection 19 between operating system 11 and message server 13. A dynamic program communication between applications (DDE - dynamic date exchange) is used as communication connection 20 between the message server 13 and the operation module 14. Communication connections 21 and 22 respectively are used for information exchange between data base 15 on the one hand and message server 13 and user module 14 respectively on the other hand, which operate with a data manipulation language for retrieving and changing of data in a relational database (SQL). A parameter module 23 is provided with special advantage being in a communications connection 24 with database 15 operating with SQL likewise. Alternatively or additionally the parameter module 23 can be connected directly to the message server 13 via a (indicated by dashed line) communication connection 25.

To the operating mode of the diagnosis system 18 in fig. 2 the following is commented:

By means of the message server 13 results the connection between the process computer nodes 2a-4e (fig. 1) and the associated technical-physical processes respectively on the one hand and the process image and the data base 15 respectively as well as the operation module 14 on the other hand. Via the USS protocol driver 12a a master/slave principle is operated, wherein the diagnosis system 18 represents the master and the process computer nodes 2a-4e the slaves. The diagnosis system 18 and the corresponding diagnosis computer 7 (fig. 1) respectively make periodic demands for the process computer nodes 2a-4e and waits for the according answer. According to the requirements of the parameter module 23 in particular, process values representing process data are requested periodically from the process computer nodes 2a-4e. If changes result from the old/new comparison (see fig. 3), the main memory process image is actualised accordingly. If additional tests or actions are required by the - client specific - programmed parameter module 23, those are initiated, particularly writing into the data base 15. During such a further processing of process data it has to be ensured, that the message server 13 is not obstructed in the periodic operation. Therefore, additional processes have to be activated by means of waiting queue functions if necessary, to decouple the operation from the telegram/data traffic temporally. If a change is recognised to be a failure, a real time data channel can be assigned to this failure particularly due to the parameter module 23, whose reading is initiated and the process data associated with the failure are stored in the data base for later analysis. The operation module 14 comprises the following functions:

- graphical display of process values, particularly their time dependent behaviour, in which

between real time or historical display of the process data archived in the database 15 can be chosen,

- logging function for recorded failures („failure message logbook" for the history),

- storing/loading of parameter sets particularly in the parameter module 23 and/or in the process computer nodes 2a-4e connected via the serial bus 9 using download techniques,

- editing of parameter sets archived in the data base 15,

- changing of single parameters of the connected process computer nodes 2a-4e online,

- functions for evaluation and analysis, particularly in correlation with said „failure message logbook",

- providing of data for systems outside of the freely configurable diagnosis system 18, for example via modem and/or ISDN connection,

- starting/stopping of the recording/archiving into the data base 15.

All those functions and services can be actuated either straight on site at the diagnosis computer 7 or via remote access service (modem) for remote diagnosis.

In the parameter module following specifications are deposited for each connected process computer node 2a-4e;

- address in the machine and/or process oriented RS 485 field bus,

- type of the node and/or the component (for example company specific, controlling system, digital signal processor etc.),

- identifier for use as variable,

- starting/stopping or fading in/out of the surveillance of the relating process computer node.

For parameters and values of the individual process computer nodes the following specifications are needed:

- parameter number, describing the address of the parameter in the process computer node;

- parameter group, in which different parameters, especially of different process computer nodes (for example digital signal processor and converter) are combined component-spanning to logical groups;

- description of parameter by providing a describing plain text,

- format of the parameter, wherein the following formats are distinguished:

- word: whole numbered value 16 Bit-integer;

- double word: whole numbered value 32 Bit-integer;

- floating point: 32-Bit floating point value according to IEEE;

- parameter type for specification of how the content of a

parameter has to be interpreted (basically status/controlling words (bit areas), reflecting certain states and state specifications respectively, and display or specification of values respectively are differentiated; examples for status words are states like „on/off", „free/locked", for display of values „actual value of rotational speed", „system deviation");

- specifications of limit values, wherein the upper and lower limits can be indicated directly or indirectly (with direct specification the values are specified here; indirect limit values point to parameters in any connected process computer node component);

- monitoring (recording) of individual parameters can be switched on or off;

- the monitoring of the limit values for individual parameters can be switched on or off;

- parameterisation of the message describing how certain incidents have to be passed on to superordinate systems, for example breach of limit values, occurrence of certain states or failures;

- real time data channel (real time pipe - RTP), which is fed in one of the connected process computer nodes (for example digital signal processor) for time critical values, whereat in a form of circular buffer the values are protocolled, in a manner of speaking „filmed", in real time (if failure arises and a RTP is assigned to this failure, the RTP is read by freely configurable diagnosis system 18, so the time dependent behaviour of this value before the occurrence of the failure is analysable particularly for objective evaluation of reasons).

According to fig. 2 an online connection module 26 is implemented particularly in correlation with the operation module 14. Additionally the online connection module 26 can also contact other software modules (indicated dashed). The online connection module 26 allows for example the addressing of all data and/or parameters of the process computer nodes 2a-4e in real time (during the running process) in combination with the operation module 14. This could be carried out either from the diagnosis computer 7 or via modem connection. A possibility for optimisation of data and parameters is created therewith (for example adjusting of the controlled parameters to the wear of machine elements in the technical-physical process). A specialist has not to be on site using modem connection or other means of long-distance data transmission. Furthermore, the (important) subprograms for example of the operation module 14 can be switched to remote diagnosis via the online connection module 26.

For remote diagnosis and connection to network topologies the following functions can be provided by the operating system 11:

- remote access service (RAS - remote diagnosis via modem);

- network connectivity (local area networks, remote systems 17) via TCP/IP and ethernet (Novell).

The message server module 13 provides real time communication between the technical processes and the process computer nodes 2a-4e accessing thereon in real time as well as the other process computer nodes 2a, 2b, 3a, 3b and the operation module 14. This function is preferably realised in the programming language C/C++ to achieve a high processing speed. According to fig. 3 the process date or process data respectively are requested by the program submodule 27 via the USS protocol or the according protocol driver 12a from the subordinate systems with technical processes and process computer nodes 2a-4e and stored in an internal table, for example. The storage takes place as a result of interpretation of the read process data according to submodule 28 particularly in combination with parameter module 23. Thereupon a query according to branching module 29 is carried out whether a difference between the previous storage of process data and the actual process data is observed. If the answer is yes, the branching into submodule 31 takes place via branch 30, by which an actualisation of the process image generated by the message server 13 takes place. Thereafter the actualised process image is archived in the data base 15 according to submodule 32. To prevent the loss of data the storing into the data base 15 can be carried out via one or more waiting queues or other buffers. The parameter module 23 functionally acts upon the data base entry controlling and/or administrating. Consecutively an optional output to the operator or user can take place according to submodule 33, either via the diagnosis computer 7 or via one of the control station process computer nodes 2a, 2b. Then the program loop shown in fig. 3 can start all over. Via the second program branch 34 a return to the beginning of the program loop takes place likewise if no difference is recognised in the old/new comparison according to branching module 29.

Claims

1. A arrangement for fault diagnosis and/or analysis of one or more technical-physical processes (5, 6), particularly electric drive processes, which run under controlling, regulation and/or observation by one or more process computer nodes (2a, 2b, 3a, 3b, 4a, 4b, 4c, 4d, 4e), **characterised in that** via at least one common bus (8, 9) the process computer nodes (2a-4e) are connected with at least one diagnosis computer node (7), in which one or more diagnosis services and/or functions (12, 13, 15) are implemented, which are assigned to the one ore more processes (5, 6) and/or the one or more process computer nodes (2a-4e) and/or the working processes running therein.

2. Arrangement according to claim 1, with a hierarchical structure of the process computer nodes (2a-4e) among each other, characterised by separate bus systems (8, 9), each assigned to a hierarchy level, the process computer nodes (2a-4e) of the respective hierarchy level communicating via those with the diagnosis computer node (7) preferably in a starlike arrangement.

3. Arrangement according to claim 2, characterised in that at least one (9) of the individual busses (8, 9) is designed for serial transmission of information.

4. Arrangement according to claims 1, 2 or 3, characterised in that the diagnosis computer node (7) is superordinate to the process computer nodes (2a-4e) within the context of a master/slave hierarchy.

5. Arrangement according to one the preceding claims, in which one or more process computer nodes (2a, 2b) are designed operator oriented, for example as control station computer, and one or more other process computer nodes (3a, 3b) are designed control oriented, for example as free programmable controls, and these process computer nodes (2a-3b) are connected to each other via a first common bus (1), characterised in that the diagnosis computer node (7) communicates via a second separate bus (8) either with the one or more operator oriented (2a, 2b) or with the one or more other, control oriented process computer nodes (3a, 3b) and also communicates indirectly via these with the one or more control operated or the one or more operator oriented process computer nodes (2a-3b), respectively.

6. Arrangement according to claim 5, with one or more field oriented, that is to say operating or accessing directly to the process using sensors and actuators, process computer nodes (4a-4e) for example digital signal processors or drive control units, which are connected to the other process computer nodes (2a-3b) via the first bus (1), characterised in that the diagnosis computer node (7) is connected to the one or more field oriented process computer nodes (4a-4e) via the third separate bus (9), which is preferably designed for serial transmission of information.

7. Arrangement according to one of the preceding claims, characterised in that the diagnosis computer node (7) comprises one or more field oriented interfaces, for example analogue/digital converters, pulse counters and/or binary switches, and/or one or more user oriented interfaces, for example keyboard and/or display, which are designed for analogue, digital and/or telecommunicative remote data transmission, for example modem and/or ISDN port (10).

8. Computer based system for failure diagnosis and/or analysis of one or more technical-physical processes (5, 6), particularly electric drive processes, for an arrangement according to one of the preceding claims, in which at least diagnosis computer node (7) communicates with one or more process computer nodes (2a-4e), and data, instructions and/or parameters can be entered and/or displayed using a operation module (14), characterised by a message server module (13), which reads process data repeatedly form the process computer nodes (2a-4e) via message protocol drivers (12) implemented on the diagnosis and process computer nodes (7, 2a-4e), and a database module (15), storing and/or archiving the data received from the message server module (13) for later access by the message server module (13), wherein the operation module (14)

communicates with the message server module (13) and the database module (15) at least partially under control of the operating system (11) in the diagnosis computer node (7).

9. System according to claim 8, characterised by a parameter module (23) acting together with the data base module (15) and/or the message server module (13) for identification and/or interpretation of the process data read by the message server module (13) and/or controlling of their storing and/or administration and/or output in/from the database module (15).

10. System according to claim 9, characterised in that the message server module (13) is coupled with the parameter module (23) directly.

11. System according to claim 8, 9, or 10, characterised in that at least the operating system (11) of the diagnosis computer node (7) is designed for multitasking and/or controls the message protocol drivers (12) as submodules.

12. System according to one of the claims 9 to 11, characterised in that the operating system (11) has one or more submodules for reading, writing, configuring and/or changing of the parameter module (23) and/or for services for remote data transmission (12b-RAS) and/or connection (12c-TCP/IP) to external computer networks.

13. System according to one of the preceding claims, characterised in that one or more tables for comparison of old and new process data of the same type, waiting queue functions and/or data buffers, which are realised in the diagnosis and/or process computer nodes (7, 2a-4e) are designed in connection with the message server module (13) for decoupling of read process data from the subsequent process data.

14. System according to one of the preceding claims, characterised by one or more real time data channels for process data between the message server module (13) and one or more process computer nodes (2a-4e).

15. System according to claim 13 and 14, characterised in that the real time data channels are connected with and/or provided with the one or more tables for comparison, data buffers and/or waiting queues, which are implemented in the diagnosis and/or process computer nodes (7, 2a-4e).

16. System according to one of the preceding claims, characterised in that the message server module (13) comprises one or more process data pipes to the diagnosis and/or process computer nodes (7, 2a-4e) for reading or process data *(this seems to be an error in the original document - the translator)* from the process computer nodes (2a-4e), particularly in connection with the one or more real time data channels.

17. System according to one of the preceding claims, characterised by a real time connection module (26), which is at least coupled

with the operation module (14) and is able to act upon this in such a way, that instructions, parameters and/or other data can be transmitted to the process computer nodes (2a-4e) via the operation module (14) and the message server module (13) and the one or more real time data channels if necessary and/or the operation module (14) is coupled with an interface (10) of the diagnosis computer node (7) for long-distance data transmissions.

18. System according to one of the preceding claims, characterised by a structure and organisation according to the principle of the commonly known client/server architecture, by which diagnosis processes, functions and/or services (12, 13, 15) are running distributed on the diagnosis and process computer nodes (7, 2a-4e).

19. Method for failure diagnosis and/or analysis of one or more technical-physical processes (5, 6), particularly electric drive operations, which are run under control, regulation and/or observation by one or more process computer nodes (2a-4e), using a system according to one of the preceding claims, characterised in that the message server module (13) requests and reads (27, 28) repeatedly parameters and other data characterising the technical physical process (5, 6) and/or working processes repeatedly and compares (29) these new process data to a process image from the data base module (15) based on older process data of the same type and generates (31) an actualised process image in case of changes and/or failures and enters (32) it into the database module (15) as well as a display program (33) is parameterised particularly in connection with the operator module (14) and/or a operator oriented process computer node (2a, 2b) if necessary.

20. Method according to claim 19, characterised in that the requested process data are buffered in a pipe, waiting queue and/or table and are transferred into the data base module (15) for archiving on detection of a change as a result of comparison (29).

21. Method according to claim 19 or 20, characterised in that the process image is left unchanged in the database (15), if no change or failure is determined in the comparison (29).

22. Method according to claim 19, 20 or 21, characterised in that the operation module (14) is used for analysis and/or graphical preparation and display of the process data particularly on an external bus (35) as failure messaging logbook, for loading and storing of parameters in the process computer nodes (2a-4e), in real time operation as well, for editing of archived data and parameter in the data base (15), for switching the operation of process data recording on and off in connection with a message server module (13) and/or for handling of the archiving in connection with the data base module (15).

23. Method according to one of the preceding claims, using a system

according to claim 9, that is to say with a parameter module (23), characterised in that the bus addresses, type identification specifications, internal identifier and monitoring flags of the process computer nodes (2a-4e) are deposited therein.

24. Method according to one of the preceding claims, using a system according to claim 9, that is to say with parameter module (23), characterised in that the values and parameters respectively of the one or more process computer nodes (2a-4e) are itemised therein, particularly according to number and address respectively of the respective process computer node (2a-4e), by logical membership to a group, combination or type of parameters, by type of the message and/or by availability of a possible real time data channel.

25. Method according to one of the preceding claims, using a system according to claim 14, that is to say with real time data channel, characterised in that at recognition of a change or failure by the message server and/or parameter module (13, 14) a real time data channel is assigned to the one or more affected process computer nodes (2a-4e) by a parameter module (23) if necessary, which is read in the database module (15) for later analysis.

26. Method according to one of the preceding claims, using a system according to claim 17, that is to say with real time connection module (26), characterised in that the real time connection module is used for real time changing and/or optimisation of data and parameter in the parameter module (23) and/or in the one or more process computer nodes (2a-4e).

27. Method according to one of the preceding claims, characterised in that the parameter and/or the message server module (23, 13) access via pointer and/or indirect addressing on the parameter values, particularly if those are stored in the process computer nodes (2a-4e).

28. Method according to claim 27, using a system according to claims 13 and 14, that is to say with real time data channels designed parallel to the data buffers and/or waiting queues, characterised in that data transmission processes in real time data channels have priority over those in waiting queues and/or data buffers.

Three pages of drawings following

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Int. Cl.[6]: G 05 B 19/048
Offenlegungstag: 16. Oktober 1997

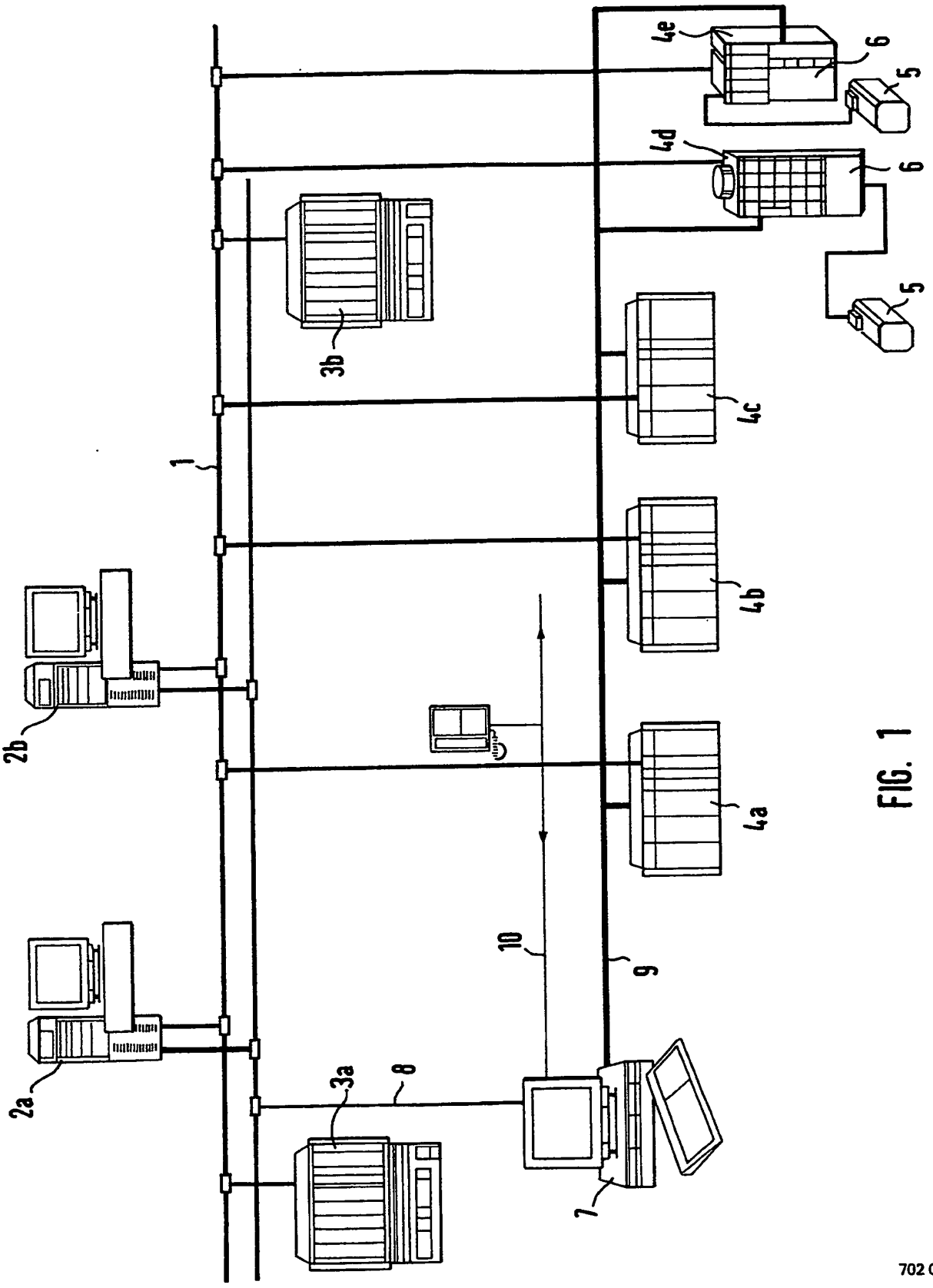

FIG. 1

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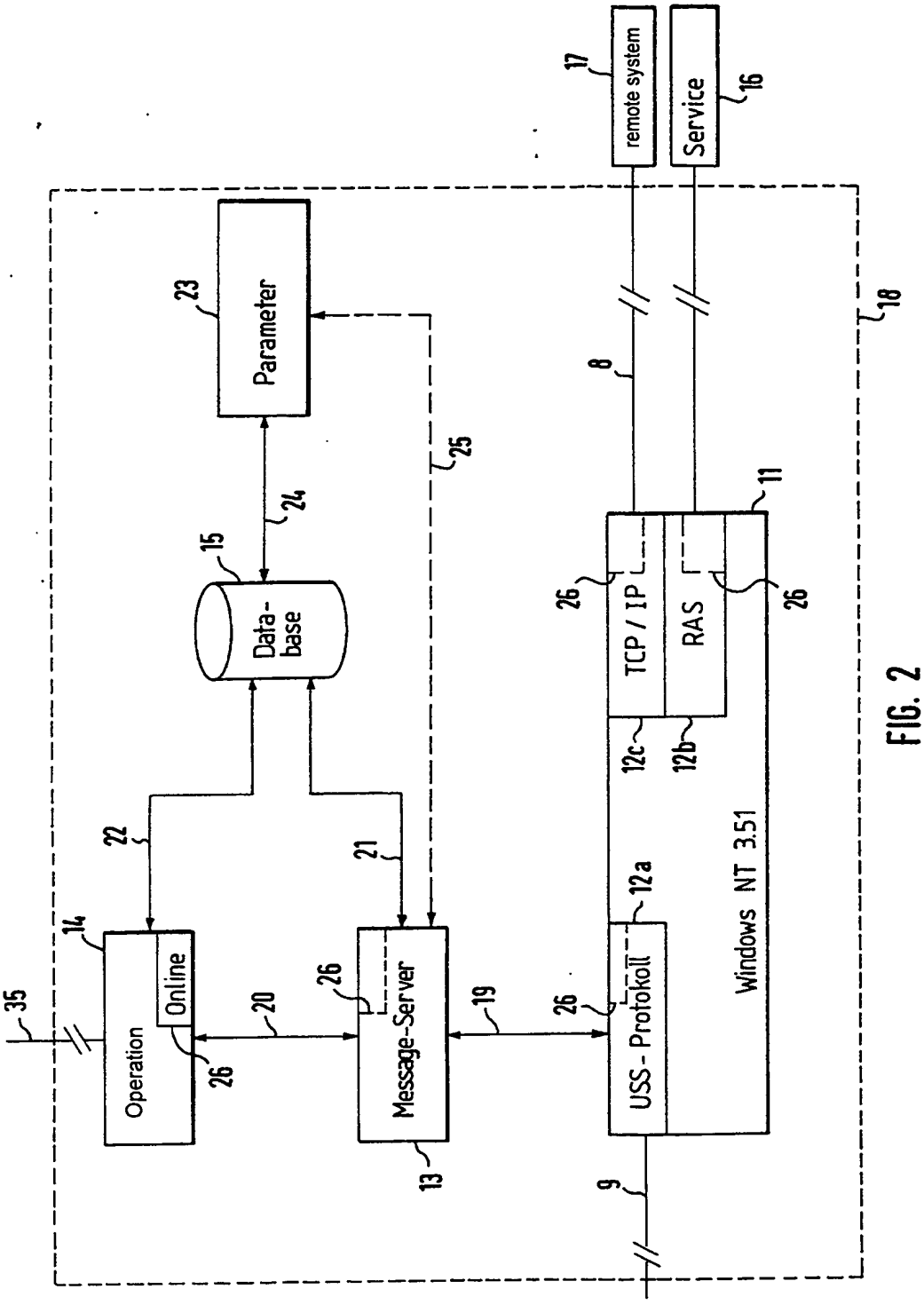

FIG. 2

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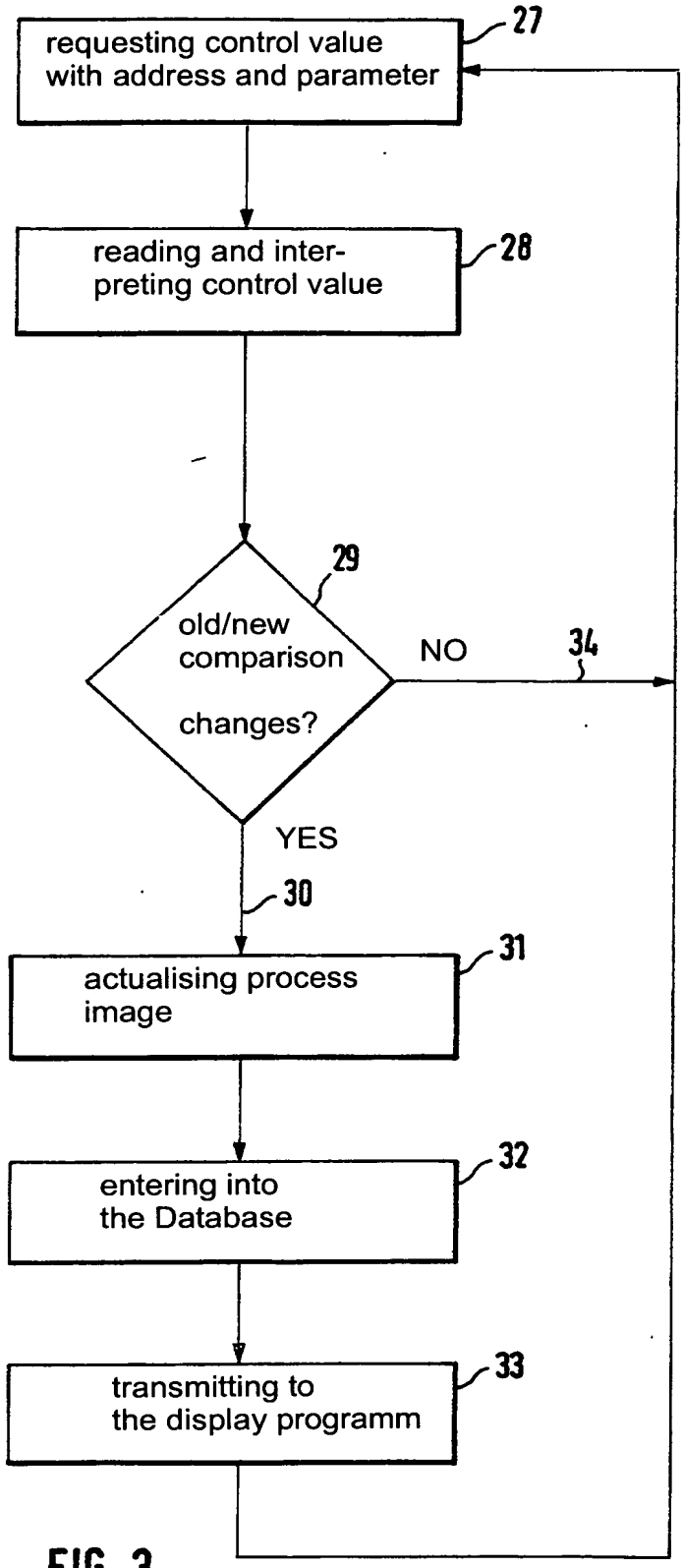

FIG. 3